

**EPA Superfund
Record of Decision:**

**NAVAL SURFACE WARFARE CENTER - DAHLGREN
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1.0 THE DECLARATION

1.1 SITE NAME AND LOCATION

Site 12 Chemical Burn Area
Naval Surface Warfare Center
Dahlgren, Virginia

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Site 12 Chemical Burn Area at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL) Dahlgren, Virginia. This

document focuses on remedial decisions for Site 12 at the NSWCDL and the term "site" in this document refers to Site 12. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The Commonwealth of Virginia concurs with the selected remedy (see Appendix A).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

1.3 DESCRIPTION OF THE SELECTED REMEDY

The Navy will manage the remediation of the Chemical Burn Area in two phases. The remedial action selected in this Record of Decision (ROD) addresses contamination associated with Site 12 Chemical Burn Area contents, surface soils, subsurface soils and groundwater. Possible contaminated surface water and sediments in Gambo Creek near Site 12 will undergo further evaluation as part of the Gambo Creek Ecological Assessment and a separate ROD will be issued for Gambo Creek.

The selected remedy for Site 12 is to remove volatile organic contaminants from groundwater and soils using an air sparging/soil vapor extraction system (AS/SVE), and provide institutional controls, and groundwater, surface water, and sediment monitoring. No action is required for surface soils at Site 12.

The major components of the selected remedy are:

The Navy shall install an AS/SVE system which consists of at least two air injection wells in the source area as defined in Figure 2-4. The vapor extraction system shall consist of at least two vapor extraction wells located in the source area and along the downgradient plume, as defined by the groundwater monitoring network. The optimum number of AS/SVE wells shall be determined by the pilot-scale study.

The Navy shall monitor the extracted vapors to ensure compliance with EPA and Virginia ARARs and TBCs as they are discharged to the atmosphere. There will be no air emission controls on the AS/SVE system, and initially up to 25 pounds per day of VOCs removed from groundwater is expected to be vented to the atmosphere. Emissions at these levels are expected to be short-term during the installation and pilot-testing of the system.

Long-term operation of the system shall, if needed, be controlled to meet the OSWER Directive 9355.0-28 limit of 15 pounds per day VOCs for air emissions from Superfund remedial actions. Controls may include reducing air flow into the aquifer, use of carbon adsorption, or other means acceptable to EPA and VDEQ.

The Navy shall institute the following institutional controls within 90 days of completion of the installation of the AS/SVE system: a real property description notation, Base Master Plan notations, and limited site access. Signs shall be posted which state that hazardous substances are present. Signs shall be removed at the completion of the remedy. The Base Master Plan shall note the area as one in which residential development cannot occur, shallow groundwater cannot be used, and site access shall be limited. A notation shall be filed in the real

property file maintained at Engineering Field Activity, Chesapeake (EFA Ches) (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present. The institutional controls shall also include the following: Within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of groundwater contamination. Monitoring well locations shall be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and shall not disturb the function of the monitoring systems. The owner of the property shall submit the survey plat to the local recording authority when closure is complete. If and when the property is transferred out of the federal government, the deed (or some other instrument which is normally examined during title search at the local land recording authority) shall include the survey plat and shall contain a notation notifying any potential purchaser of the property that the land has been used to manage solid waste. An appropriate deed restriction shall be placed on the site-specific deed when a deed is created in the future for property transfer.

The Navy shall institute groundwater monitoring at the perimeter of the groundwater plume. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Management Plan.

The Navy shall monitor the surface waters and sediments in Gambo Creek adjacent to Site 12. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Management Plan.

Implementation of the selected remedy will address the principal threats at the site by reducing the potential risk to human health and the environment associated with the subsurface soils and groundwater. Additionally, this remedy would be able to address the potential presence of Dense Non-Aqueous Phase Liquid (DNAPL) beneath the site.

1.4 STATUTORY DETERMINATIONS

The selected remedy for Site 12 is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to this action, and is cost-effective.

The selected remedy for Site 12 addresses the remediation of subsurface soils and groundwater contamination at Site 12. The selected remedy will provide for the long-term reduction of contamination in subsurface soils and groundwater beneath the site. The installation of an air sparging/soil vapor extraction system will reduce direct contact and ingestion threats and reduce risks to ecological receptors from contaminated subsurface soils and groundwater by removing contaminants from these media.

The selected remedy for Site 12 will be constructed to meet all applicable or relevant and appropriate requirements (ARARs) whether chemical-, action-, or location-specific. No waivers of any ARARs are requested. Air sparging/soil vapor extraction is a permanent solution and is an appropriate remedy for volatile organic contamination in soils and groundwater. Air sparging is an innovative technology whose application at Site 12 is considered technically superior to other alternatives.

This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for this operable unit, and satisfies the statutory preference for treatment as a principal element.

A review will be conducted within five years after commencement of the remedial action to ensure that the remedy provides adequate protection of human health and the environment.

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) is issued to describe the Department of the Navy's (Navy) selected remedial actions for Site 12, Chemical Burn Area, at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL), Dahlgren, Virginia (Figure 2-1). The Chemical Burn Area is one of several Installation Restoration (IR) sites (Figure 2-2) located at the NSWCDL facility. Site 12 is situated on the Mainside of the base and is bounded on its western side by Gambo Creek (Figure 2-3).

The Chemical Burn Area, which included a small pit, was used for burning lab chemicals, solvents, polymers, glues, metallic hardware and equipment, and small quantities of decontaminated chemical warfare agent (CWA) solution. The former pit and associated facilities were located in a fenced, cleared area of the site at the end of a dirt access road off of Bagby Road (Figure 2-3). The size of the pit is estimated from aerial photography to be approximately 50 feet square. An employee of the area stated that in the early 1970s the pit was approximately 20 feet long by 20 feet wide and 4 feet to 6 feet deep.

Adjacent land has been used for the disposal of ordnance-related wastes (Site 2), as an aerial bombing range, and as a natural habitat for native plant and animal species. A Remedial Investigation (RI) and Feasibility Study (FS) has been conducted at the adjacent Site 2, and a separate Record of Decision is being prepared to address that site. Laboratory and office space are located within 1,500 feet to the northeast of Site 12 and within 1,000 feet to the southwest of the site.

Surface drainage from Site 12 is generally overland directly to Gambo Creek. Gambo Creek is located approximately 350 feet west of the former burn pit. Because the highest ground is near the center of the clearing, there is some surface runoff in the opposite direction toward a drainage ditch east of Bagby Road, which drains into an unnamed tributary of Gambo Creek.

Groundwater production wells supplying potable water to NSWCDL are over 600 feet deep and are located over 4,000 feet south of Site 12. These wells are unaffected by contaminants related to Site 12. Depth to the surficial groundwater at Site 12 ranges from approximately 2-10 feet below ground surface, and is tidally influenced by Gambo Creek. Analytical results from the surficial aquifer at Site 12 indicate that untreated groundwater is not suitable for potable use, because of high total dissolved solids (TDS) and chloride (3,800 mg/l) levels.

The closest residences, on-base Navy housing consisting of over 150 homes, are within 6,000 feet southwest of Site 12.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 History of Site Activities

Activity in the vicinity of Site 12 first began about 1952 when a 600 by 600 foot area was cleared of vegetation. Prior to this, the Site 12 area was densely vegetated. Aerial

photographs from 1967 show an access road leading to a rectangular fenced area containing two separate pits. The pits were first observed somewhere between 1964 and 1967. The two pits in the fenced area were observed as one consolidated pit in 1981 aerial photography. It was reported that fuel (typically No. 2 fuel oil) had been used to burn laboratory materials and metallic hardware and equipment at the pit.

Quantities of decontaminated CWA solution, rendered safe in the laboratory by neutralization with caustic soda ash, bleach, and alcohol-based caustic solutions, were also destroyed by burning at Site 12. A total of approximately 300 gallons of liquid neutralized material was disposed of in the pit over the life of operation. The last burn was conducted in September 1980. According to NSWCDL personnel, the last use of the pit was in October 1982, when approximately 60 quarts of a sodium hypochlorite solution of unknown strength were disposed of in the pit, but not burned.

In 1986 aerial photography, the pit and fence at Site 12 were no longer visible due to the amount of vegetation present within the fenced area. By November 1986, the fence and gate were removed and the burn pit was filled in by regrading the area. Known or potential wastes disposed of at Site 12 include fuel oils, spent solvents, metals, caustics, hypochlorite, polymers, glues, and decontaminated CWA solution.

2.2.2 Previous Investigations

The first investigation of the Chemical Burn Area (Site 12) was the Initial Assessment Study (IAS) conducted in 1981 by Fred C. Hart Associates, Inc. The IAS included a records review, personnel interviews, and a site visit. The IAS identified that small metered quantities (about 1 quart) of decontaminated CWA had been burned at the site (Fred C. Hart & Associates, 1983). The IAS recommended that a Confirmation Study be conducted at Site 12 to ascertain the potential for impacts on the surrounding environment.

The Confirmation Study at Site 12 was conducted in 1983 and 1984. Samples of Site 12 soil and groundwater, surface water from Gambo Creek, and standing water in the burn pit were analyzed for chloride, iron, manganese, phenol, sodium, sulfate, total organic carbon (TOC), and total organic halides (TOX). In addition, one pit water sample and one subsurface soil sample were scanned for the presence of base-neutral or acid-extractable organic compounds (BNAs) and pesticides/polychlorinated biphenyls (PCBs). Four monitoring wells were installed in 1983 outside the former fenced area. Based on projected groundwater flow directions, the wells were situated to provide data at three downgradient and one upgradient locations with respect to the pit. Groundwater samples were reported in 1986 (O'Brien and Gere, February 1986).

Based on the results of the Confirmation Study, which demonstrated the potential for organic contamination in the soils and groundwater, the site was scheduled for additional Remedial Investigation (RI) sampling.

2.2.3 Enforcement Actions

There have been no enforcement actions taken at Site 12. The Navy has owned this property since the early 1900's and is identified as the responsible party.

2.2.4 Highlights of Community Participation

In accordance with Section 113 and 117 of CERCLA, the Navy held a public comment period from July 16, 1997 through August 15, 1997 for the proposed remedial action described in the Feasibility Study for Site 12 and in the Proposed Plan.

These documents were available to the public in the Administrative Record and information repositories maintained at the Smoot Memorial Library, King George, Virginia: the Dahlgren Laboratory General Library, Dahlgren, Virginia: and the Dahlgren Laboratory Public Record Room, Dahlgren, Virginia. Public notice was provided in The Freelance Star newspaper on July 15, 1997 and a Public Meeting was held in the King George Administration Building on August 6, 1997. No written comments were received during the comment period and the comments and responses provided during the Public Meeting are presented in Appendix B.

2.3 SCOPE AND ROLE OF RESPONSE ACTION SITE 12

Past waste burning operations at the site have contaminated subsurface soil and groundwater. The Navy has decided to manage the remediation of the site as a single unit. The proposed remedial actions identified in this ROD address contamination associated with Site 12, Chemical Burn Area, as identified in the Draft Final RI Report, the Addendum RI Report, and the Feasibility Study (FS) Report for Site 12. Several alternatives for response actions for contaminated media are identified in Section 2.6. The rationale for selecting one of those alternatives as the remedy for this site is described in Section 2.7.

The selected remedy uses air sparging/soil vapor extraction (AS/SVE) to remove 1,1,1-trichloroethane (1,1,1-TCA) from the groundwater and subsurface soils and to remove 1,1-dichloroethane (1,1-DCA) from groundwater to achieve remediation goals. Should the AS/SVE technology not be capable of achieving remediation goals within a reasonable time frame, not to exceed 30 years, the source of the contamination, subsurface soils, shall be excavated and appropriately disposed of at an offsite disposal facility. The remedy will reduce the potential risk to the environment associated with 1,1,1-TCA and 1,1-DCA migrating to Gambo Creek and impacting ecological receptors. The selected remedy will involve pumping air into the groundwater through air sparging wells and withdrawing the volatilized contaminants through soil vapor extraction wells.

The off-gas from the system will be monitored to comply with applicable or relevant and appropriate requirements (ARARs).

This selected remedy is consistent with long-term remedial goals for Site 12. The remedial action will help to reduce the volume of wastes in soil and groundwater, thereby reducing the principal threat to ecological receptors in Gambo Creek from the migration of subsurface soil and groundwater contaminants to sediments.

The remedy will not address surface water and sediment at Site 12. Remediation of these media will be deferred to the Gambo Creek Ecological Study.

2.4 SUMMARY OF SITE CHARACTERISTICS

The RI at Site 12 was completed in phases. Geophysical investigations and radiological investigations were initiated in 1993. Sampling activities, consisting of soil sampling, surface water and sediment sampling, and the installation and sampling of groundwater monitoring wells, were completed in 1994. Additional RI sampling, consisting of additional surface and subsurface soil sampling and groundwater monitoring activities were completed in 1996. The results of the RI are summarized below.

2.4.1 Sources of Contamination

Geophysical and hydrogeologic investigations at Site 12 were conducted to identify disturbed areas and burned metallic hardware and equipment, and to investigate the extent of the burn pit. The results of the survey indicated the presence of metallic objects and other geophysical anomalies in the pit. Based on groundwater and subsurface soil sampling results, the source of groundwater contamination is the wastes present in the Chemical Burn Pit Figures 2-4 and 2-5 indicate the extent of the contamination in soils and groundwater above Preliminary Remediation Goals (PRGs) respectively.

2.4.2 Description of Contamination

Soil, groundwater, surface water, and sediment samples were collected and analyzed for a variety of parameters to determine the nature and extent of contamination at Site 12. The major contamination concerns at Site 12 are associated with the former burn pit. Subsurface soil and groundwater have been impacted by the waste disposal activities that occurred there. The results of the sampling and analyses are presented below.

Surface and Subsurface Soils

Elevated concentrations (130 mg/kg maximum) of chlorinated solvents 1,1,1-TCA and degradation products (i.e., 1,1-DCA and 1,1-dichloroethylene [1,1-DCE]) and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds were detected in the subsurface soils within the former pit. The detected concentrations of BTEX compounds (0.001 to 4.2 mg/kg) were relatively low compared to chlorinated solvents. The extent of 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and BTEX contamination within the vadose zone soils appears to be limited to soils in the vicinity of the approximate center of the former pit. Phthalates, polynuclear aromatic hydrocarbons (PAHs), and elevated levels of arsenic (13 mg/kg), copper (611 mg/kg), lead (182 mg/kg), and zinc (419 mg/kg), as compared to background levels, were also determined to be limited to the subsurface soils in the vicinity of the pit at depths exceeding 3 feet below ground surface (bgs).

Surface soils exhibited much lower concentrations of volatile organic compounds (VOCs) and metals as compared to the pit. PAHs (15-160 ug/kg) and pesticides (4.9-150 ug/kg) were also detected at low concentrations in surface soils.

Groundwater

Elevated concentrations (100,000 ug/L) of chlorinated solvents (1,1,1-TCA and degradation products) and toluene were also detected in the brackish shallow aquifer. Federal maximum contaminant levels (MCLs) for 1,1,1-TCA, 1,1-DCE, and toluene were exceeded in several samples. The highest concentrations of VOCs (100,000 ug/L) were present in the bottom of the shallow aquifer (GW12-8D) at the pit. The concentrations of 1,1,1-TCA and related compounds are lower (3,800 ug/L) in the upper portion of the shallow aquifer (GW12-8) and in downgradient monitoring wells GW12-6 and GW12-9. The extent of 1,1,1-TCA and degradation product contamination in the shallow aquifer may extend to Gambo Creek. The closest well to Gambo Creek, GW12-7, contains trace levels of 1,1,1-TCA (4 ug/L). Free product was not found during either phase of the RI investigation; however, the highest concentration of 1,1,1-TCA of 100,000 ug/L suggests that there is a high potential for Dense Non-Aqueous Phase Liquid (DNAPL) to be present at Site 12. Inorganics were also detected in Site 12 groundwater. Concentrations of aluminum (73,400 ug/L), cadmium (2.3 ug/L), chromium (104 ug/L), iron (67,600 ug/L), lead (82.7 ug/L), manganese (1,040 ug/L), mercury (0.21 ug/L), thallium (5.3 ug/L), and zinc (270 ug/L) exceed MCLs or Virginia Groundwater Standards or, in the case of lead, exceeds the Federal

Safe Drinking Water Act action level of 15 ug/L.

Surface Water and Sediment

1,1,1-TCA and degradation products were not detected in any of the surface water samples collected from Site 12, but this failure to detect may have been due to volatilization and dilution. Trace concentrations of 1,1,1-TCA and 1,2-DCE (total) were detected in Site 12 sediment samples from Gambo Creek. This trace contamination may be the result of overland flow of contaminants from Site 12 soils or due to groundwater discharging to Gambo Creek. Although Aroclor-1260 and mercury were frequently detected in sediment from Gambo Creek, there is no strong evidence that Site 12 is the sole source. Aroclor-1260 was detected only in surface soil in 3 of 17 samples at a maximum concentration of 150 ug/kg. The location of the sample containing the highest concentration of PCB is over 400 feet east of Gambo Creek. Mercury was detected in only one groundwater sample and 2 of 17 surface soil samples at concentrations lower than those detected in sediment samples. This suggests that Aroclor-1260 and mercury detected at Site 12 may not be the sole source of the sediment contamination detected in Gambo Creek.

2.4.3 Contaminant Migration

Minor levels of contamination were detected in the surface soils that surround Site 12. Release and transport of contamination from Site 12 surface soils may occur by volatilization and particulate emissions during soil excavation, soil erosion, and from leaching from the soil to the groundwater. Leaching of contaminants from the surface soils and the subsurface soils occurs predominantly in a vertical direction. Precipitation infiltrating through the bum pit does leach contaminants from the wastes. VOCs have been detected at high levels in the groundwater beneath Site 12.

There is evidence that natural processes are causing concentrations of VOCs to decrease at the site. In the absence of naturally occurring processes, and given the groundwater velocity (approximately 300 feet per year), the elapsed period of time since the last use of the Site 12 pit (approximately 10 years), and the distance to Gambo Creek (approximately 500 feet), the concentrations downgradient of the source should be significantly higher than current concentrations. However, contaminant concentrations at downgradient monitoring wells are several orders of magnitude lower than concentrations at the source. Natural processes including dispersion, diffusion, sorption, abiotic degradation, and biodegradation typically affect the movement of contaminants within aquifers and may be responsible for the lower downgradient concentrations at Site 12. Of these processes, sorption probably has the greatest effect upon contaminant migration. Sortive processes near the source would cause the bulk of contamination to remain relatively close to the source. Degradation of 1,1,1-TCA has apparently led to the creation of daughter products such as 1,1-DCA and 1,11-DCE through anaerobic processes. There is, as of yet, no evidence of vinyl chloride, a by-product of 1,1-DCE degradation. This may be due to chemical oxidation and reduction conditions that are not suitable for the native microorganisms to degrade 1,1-DCE further.

2.5 SUMMARY OF SITE RISKS

The human health and ecological risks associated with exposure to contaminated media at Site 12 were evaluated in the RI Report Addendum. The residential use scenario was not evaluated because the current and anticipated future use of the site is industrial. Institutional controls will be implemented to limit the site to future industrial use and exclude shallow groundwater use. Due to its brackish quality and productivity constraints, groundwater in the shallow aquifer is not a current source of drinking water and will not be used as one in the future. Exposure to surface water is expected to be limited to fishermen in boats on Gambo Creek.

An ecological evaluation was also performed to evaluate potential threats to ecological receptors. A summary of the human health and ecological risks associated with the site is presented below.

Because many contaminants have the ability to migrate from one medium to another (e.g., soil to groundwater), assessing risks from observed levels of contaminants is insufficient to evaluate all the risks that may be presented at a site. Fate and transport modeling was therefore completed to determine if levels of Contaminants of Concern might migrate to other media and present unacceptable future risks to potential receptors. Preliminary Remediation Goals (PRGs) were developed for COC's in all media to establish concentrations that would not produce unacceptable risks.

2.5.1 Human Health Risks

Exposure Pathways and Potential Receptors

Access to the base is currently restricted by fences and security guards. Onsite workers visit Site 12 infrequently. These workers may be exposed to minor surface soil contamination. Access to Gambo Creek, is unrestricted: however, it is rarely used for recreational purposes.

Base workers, recreational users (adults and children on-site and on Gambo Creek adjacent to Site 12), and construction workers were evaluated as potential receptors in the quantitative risk assessment. Base workers and recreational users were considered for both current and future conditions. Construction workers were evaluated for future conditions only. Base workers, recreational users, and construction workers were evaluated for incidental ingestion of soil and dermal contact with soil. In addition, adult recreational fishermen were quantitatively evaluated for fish ingestion. Construction workers were evaluated for exposure to surface/subsurface soil (0 to 12 feet), while surface soil (0 to 2 feet) exposure was considered for all other receptors. Potential exposure to groundwater by construction workers was not evaluated because it was not considered to be a reasonable exposure scenario. Inhalation of volatile emissions and fugitive dust was evaluated qualitatively via a comparison of site data to U.S. Environmental Protection Agency (EPA) generic soil screening levels for transfers from soil to air. Inhalation exposure was considered to be relatively insignificant for industrial use.

Although maximum detections of 1,1-dichloroethene and benzene in subsurface soil exceeded Soil Screening Levels (SSLs), these chemicals are detected infrequently (i.e., in 3 out of 38 samples). Direct contact with surface water and sediment is not anticipated at the site because inhospitable conditions associated with Gambo Creek make direct contact unlikely. Human health risks are within acceptable ranges for industrial use at Site 12.

Exposure Assessment

Although various chemicals (i.e., VOCs, semivolatile organic compounds (SVOCs), and metals) were detected in the environmental media for Site 12, the list of contaminants of concern (COCs) for the site is limited under the industrial use scenario. Arsenic was the only COC identified for soil (surface and subsurface); the only COC for fish tissue was 1,1,2,2,-tetrachloroethane.

Toxicity Assessment

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed units of (mg/kg-day)⁻¹, are multiplied by the estimated

intake of a potential carcinogen, in mg/kg/day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPFs. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effect. RfDs, which are expressed in units mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Risk Characterization

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminants reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Current Base Worker. The cumulative hazard indices for ingestion of and dermal contact with soils for Site 12, under industrial land use conditions are less than 1, which indicates that there are no significant hazards associated with soils at Site 12. The cumulative ingestion and dermal contact incremental cancer risk is 5.6×10^{-7} , under a "reasonable maximum exposure" scenario, well below EPA's target risk range of 1×10^{-6} to 1×10^{-4} .

Adult Recreational User. The cumulative noncancer hazard index (HI) from exposure via ingestion of and dermal contact with Site 12 soils, under industrial land use conditions are less than 1, as is the risk associated with the potential ingestion of fin fish. The cumulation ingestion and dermal contact cancer risk is 7.4×10^{-7} under a reasonable maximum exposure scenario, well below EPA's target risk range of 1×10^{-6} to 1×10^{-6} .

Child Recreational User. The cumulative hazard index and incremental cancer risk associated with ingestion and dermal contact exposure to surface and subsurface soil at Site 12 under industrial land use scenario are 2.2×10^{-2} and 1.3×10^{-4} respectively under a reasonable maximum exposure scenario.

Construction Worker. The cumulative hazard index and incremental cancer risk associated with ingestion and dermal contact exposure to Site 12 soil under industrial land use conditions are 5.2×10^{-2} and 4.0×10^{-7} respectively under a reasonable maximum exposure scenario.

The incremental lifetime cancer risks for all receptors were less than 1×10^{-6} except for the reasonable maximum exposure (RME) child. The cancer risk for the RME child (1.3×10^{-6}) slightly exceeded 1×10^{-6} , but was within the EPA's target risk range, 1×10^{-4} to 1×10^{-6} .

Estimated Hazard Indices (HIs) for all receptors under industrial land use conditions, were at least two orders of magnitude below unity (1.0), which indicates that there are no significant hazards associated with soils at Site 12. Therefore, exposure to noncarcinogens in site media is not expected to cause adverse health impacts for human receptors. Human health baseline risks are not greater than the risk range, however action is being taken at Site 12 to protect potential environmental receptors..

There are several aspects of uncertainty associated with the risk assessment conducted at Site 12. Each is briefly discussed in this section. The major issues of uncertainty specific to Site 12 are as follows:

While the USEPA recognizes lead as a B2 carcinogen, no cancer slope factor has been assigned to this chemical. Currently, risks associated with lead are estimated in terms of predicted blood lead levels in small children (ages 7 and under) by using the Integrated Exposure Uptake Biokinetic Model. Typically, lead does not become a significant risk factor unless the concentrations exceed 400 mg/kg in residential soil (USEPA, 1994b) and 15 ug/L in drinking water. Lead is not considered to be a COC for soil at the site since the maximum detected concentrations of lead are less than 400 mg/kg. Although the maximum site detection of lead in groundwater exceeds 15 ug/L, groundwater is not expected to be used as a potable water supply because of brackish conditions and productivity constraints. No USEPA Region III COC screening level is available for exposure to lead in fish. However, the maximum surface water concentration for this chemical (1.3 Ig/L) was well below the 50 ug/L Federal Ambient Water Quality Criteria (AWQC) for the protection of human health (consumption of water and organisms). Future impacts of groundwater contamination on surface water are not expected to result in exceedances of Federal AWQC. Although lead was detected in a few historical groundwater samples at concentrations exceeding the Federal AWQC, dilution in the water body would reduce groundwater impacts. Therefore, the potential risks associated with exposure to this chemical are considered to be minimal.

Because of the lack of toxicity criteria. USEPA Region III COC screening levels could not be calculated for a few chemicals detected in the soil and surface water at the site (benzo(g,h,i)perylene, calcium, magnesium, sodium, and potassium). This may lead to a slight underestimation of potential risks. However, the underestimation is expected to be minimal since overall exposure to PAHs is adequately addressed by the evaluation of other PAHs, and the remaining inorganics are essential nutrients, commonly detected in environmental media.

Because of the relatively small data set, the maximum surface water concentration was used to assess potential RME risks for recreational users via fish ingestion. Consequently, the human health risks associated with this exposure route may be overestimated since it is highly unlikely that the true exposure concentration for surface water, to which a receptor is exposed over the entire exposure period, is equal to the maximum detection.

In order to be conservative, analytical results for unfiltered surface water samples were used to estimate potential human health risks for fish ingestion. It is believed that data for filtered samples more closely approximates the bioavailable fraction of inorganic in surface water than the unfiltered data. Therefore, estimates of fish uptake based on unfiltered sample data for inorganics may result in overestimates of fish tissue concentrations and the associated human health risks associated with fish consumption.

The calculated risks for the fish ingestion pathway are based on estimates of uptake from surface water and do not account for the uptake of contaminants from sediment. Thus, the risks for the fish ingestion pathway may be underestimated. Chemicals present in sediments, as opposed to surface water, may be of greater concern for bioaccumulation in fish. A presentation of the sediment results for Site 12 is provided in the Draft Final RI Report, Volume 1, Section 9.4.4 (B&R Environmental, 1995).

2.5.2 Environmental Evaluation

The intent of the baseline ecological risk assessment (ERA) was to characterize potential receptors and to estimate the potential hazard or risk to environmental receptors. Contaminant pathways were identified to evaluate receptors potentially at risk. The ERA followed EPA guidance for performing ecological risk assessments and was approved by Region III, EPA's Biological Technical Assistance Group (BTAG). The baseline ERA is described fully in the RI Report, and is briefly summarized here.

Analytical data compiled from the RI were analyzed using EPA Region III guidance for screening-level risk assessments and to determine environmental effects quotients (EEQs). Data was reviewed for surface water, sediment, and soil. Ecological receptors were assumed to be exposed to surface soil at Site 12 as well as to surface water and sediments sampled from adjacent portions of Gambo Creek to the southwest and an unnamed tributary of Gambo Creek located east of the site. EEQs were determined by comparison with standard guidelines such as EPA Region III, BTAG guidelines and Virginia water quality standards. These guidelines were used to evaluate risks from exposure to surface waters and sediment. Similar guidelines, protective of terrestrial wildlife, were used to evaluate surface soil contamination. Preliminary COCs (PCOCs) were selected for each exposure media by comparing maximum site concentrations to screening values, which typically are conservative. COCs were selected from PCOCs by comparing maximum site concentrations to preliminary remediation goals (PRGs). Those chemicals exceeding PRGs and potentially posing an actual risk to receptor populations living on or near Site 12 were selected as COCs (Table 2-1). Decisions regarding whether or not to remediate a contaminant were made by comparing maximum site concentrations to background levels, and by considering the frequency of detection, the likelihood that a source exists on the site, and bioavailability. The risk management process involved the use of information from the ecological risk assessment, and Table 2-1 presents the results of that assessment.

EEQs for contaminants found in surface water and sediments are presented in the FS. The concentration of surface soil contaminants at Site 12 do not pose an ecological risk and do not warrant remediation.

Copper in surface water and mercury in sediments remain a concern for ecological risk, but since they do not appear to be solely related to Site 12, they will be considered in the Gambo Creek Ecological Assessment, along with the other metals and pesticides in sediment, and PCBs in fish tissue.

2.5.3 Development of Preliminary Remediation Goals (PRGs)

Contaminant fate and transport modeling is used to evaluate the potential for COCs identified by the human health and ecological risk assessment to migrate to other media and present unacceptable risks. For example, contaminants present in soils could migrate to groundwater or be carried with precipitation to surface water or sediments at a site.

In order to evaluate this potential, fate and transport modeling was conducted for Site 12 using the ECTran model. The model uses contaminant properties such as solubility, and site-specific

characteristics such as depth to groundwater, to predict acceptable levels of COCs in soil and groundwater that would be protective of surface water and sediment. Regulatory criteria for surface water and sediment were used in the modeling to develop PRGs for soil and groundwater. A complete discussion of the use of modeling and assumptions is presented in the Site 12 FS.

Potential migration of COCs evaluated for Site 12 by the ECTran model included:

- ò Surface soil to surface water via runoff
- ò Surface soil to sediment via runoff
- ò Surface soil to surface water via groundwater
- ò Subsurface soil to surface water via groundwater
- ò Subsurface soil to sediment via groundwater
- ò Groundwater to surface water
- ò Groundwater to sediment

PRGs were developed by modeling for the following COCS:

Inorganics

- ò Aluminum
- ò Arsenic
- ò Barium
- ò Chromium
- ò Copper
- ò Iron
- ò Lead
- ò Manganese
- ò Mercury
- ò Silver
- ò Thallium
- ò Zinc

Volatile Organic compounds

- ò 1,1-DCA
- ò 1,1,1-TCA
- ò Toluene

Pesticides and Other Organics

- ò 4,4-DDD
- ò 4,4-DDE
- ò 4,4-DDT
- ò Endrin Aldehyde

This list includes COCs identified by the human health risk assessment and most of the metals identified as COCs in the ecological risk assessment

The COCs that were not modeled were not attributable to Site 12 as a current source, or had borderline toxicity potential, or were common laboratory contaminants, or had concentrations not different from background levels. It was determined by modeling that 1,1,1-TCA was present in subsurface soils at levels slightly above the PRG for the protection of sediment via the leachate to groundwater to sediment exposure scenario. VOCs 1,1-DCA and 1,1,1-TCA were identified at levels in groundwater exceeding PRG's for the protection of sediment at the site

boundary.

Concentrations of the contaminants of concern in each medium of exposure are found in Tables 2-2, 2-3, and 2-4.

TABLE 2-2

SUMMARY OF SURFACE SOIL PRGs - (mg/kg) - SITE 12
NSWCDL, DAHLGREN, VIRGINIA

Chemical of Concern	Soil Sampling Results	Preliminary Remediation Goals	
	Range of Detected Values	Protection of Sediment	Protection of Surface Water
Organics			
4,4-DDT	0.0049 - 0.018	10.7	12.4
4,4-DDD	0.014 - 0.031	2.00	4.73
4,4-DDE	0.037	9.76	21.1
Endrin Aldehyde	0.0071 - 0.0097	0.042	NA
1,1-Dichloroethane	0.003 - 0.028	0.0818	832
1,1,1-Trichloroethane	0.001 - 0.220	0.378	939
Toluene	0.002 - 0.032	1.77	5,700
Inorganics (total metals)			
Aluminum	3,890 - 17,400	20,000 (1)	309,000
Arsenic	2.1 - 5.2	77.4	5.320
Barium	27.9 - 65.5	300 (1)	29.300
Chromium	5.5 - 28.1	409	809
Copper	4.1 - 12.9	298	587
Iron	5,460 - 21,800	32,100	521,000
Lead	7.9 - 92.4	241	5,430
Manganese	17 - 116	475	19,800
Mercury	0.04 - 0.36	0.785	2.43
Silver	0.52 - 3.6	4.09	51.1
Thallium	1.1	NA	809
Zinc	15.8 - 44.7	453	15,600

NA Not Applicable.

- The PRG is based on the upper range of the background concentration for the NSWCDL site or for the Maryland Coastal Plain (B&R Environmental, 1995), whichever is higher. All soil containing concentrations above this value will be considered site related and will be considered for remediation. All soils with concentrations below this value will be considered naturally occurring.

TABLE 2-3

SUMMARY OF SUBSURFACE SOIL PRGs - (mg/kg) - SITE 12
NSWCDL DAHLGREN, VIRGINIA

Chemical of Concern	Soil Sampling Results	Preliminary Remediation Goals	
	Range of Detected Values	Protection of Surface Water	Protection of Sediment
Organics			
4,4-DDE	0.017	>1.0 x 10 ⁶	>1.0 x 10 ⁶
Benzene	0.014 - 2	292	12.2
1,1-Dichloroethane	0.003 - 10	1,300	63.0
1,1-Dichloroethene	0.004 - 0.78	2,060	859
1,1,1-Trichloroethane	0.003 - 130	1,180	39.5
Endrin Aldehyde	0.011 - 0.028	NA	NA
Toluene	0.001 - 1.1	>1.0 x 10 ⁶	>1.0 x 10 ⁶
Inorganics (total me Is)			
Aluminum	1,530 - 14,900	>1.0 x 10 ⁶	>1.0 x 10 ⁶
Arsenic	1.3 - 13.4	664,000	25,600
Barium	5.5 - 141	>1.0 x 10 ⁶	7,270
Cadmium	32.1	550,000	3,490
Chromium	3.1 - 58.3	88,100	136,000
Copper	1.9 - 611	78,400	99,600
Iron	1,540-33,200	>1.0 x 10 ⁶	>1.0 x 10 ⁶
Lead	1.9 - 182	>1.0 x 10 ⁶	347,000
Manganese	2.9 - 64	>1.0 x 10 ⁶	157,000
Silver	1.6 - 15.5	NA	1,350
Zinc	3.4 - 419	>1.0 x 10 ⁶	149,000

Shaded COC which exceeds PRGs.

NA Not applicable.

TABLE 2-4

SUMMARY OF GROUNDWATER PRGs - (Ig/L)
NSWCDL DAHLGREN, VIRGINIA

Chemical of Concern	Range of Detected Values (All Sampling Results)	Preliminary Remediation Goals	
		Protection of Surface Water	Protection of Sediment
Organics			
Endrin Aldehyde	0.19	NA	1.83
RDX	1.2 - 4.7	NA	NA
1,1,2,2-Tetrachloroethane	2	NA	NA
1,1-Dichloroethane	1.1 - 11,000	201,000	9,650
1,1-Dichloroethene	1 - 6,200	1,830,000	75,600
1,1,1-Trichloroethane	1 - 100,000	208,000	5,320
Toluene	2 - 1,700	>1.0 x 10 ⁹	354,000,000
Inorganics (total and dissolved metals)			
Aluminum	22.6 - 73,400	>1.0 x 10 ⁹	>1.0 x 10 ⁹
Arsenic	1.75 - 19.6	3,140,000	122,000
Barium	9 - 438	19,500,000	26,600
Cadmium	0.8 - 2.3	1,250,000	7,800
Chromium	4 - 104	542,000	832,000
Copper	3 - 93.45	250,000	320,000
Iron	29 - 67,600	839,000,000	8,410,000
Lead	1.3 - 82.7	10,100,000	60,700
Manganese	4.7 - 1,040	16,800,000	494,000
Mercury	0.21	2,150	788
Selenium	4.2	90,000	11,500
Thallium	5.3	901,000	NA
Zinc	13 - 270	16,300,000	339,000

Shaded COC which exceeds PRGs.

NA Not applicable.

Exposure Pathways

The exposure pathways consist of dermal absorption and ingestion of chemicals from soil, sediments, and surface water.

Exposure Assessment

Six constituents in sediment, five constituents in surface water, and seven inorganics in surface soils were identified as COCs for ecological receptors (Table 2-1). The EEQ for each of these contaminants was determined to be greater than 1. The EEQ for each of the other contaminants was determined to be less than one.

Potential Receptors

The organisms most likely to be receptors include mice, voles, rabbits, earthworms, other ground insects, fish, and a variety of birds. Because of the open nature of Site 12 and the variety of nearby habitats, Site 12 is likely to have a great diversity of wildlife.

Risk Characterization

Several inorganics in the sediment at Site 12 may represent a potential risk to ecological resources (Table 2-1). However, sediment remediation was deferred to the Gambo Creek Ecological Study. Surface water and sediment monitoring will be part of the selected remedy to ensure that excessive risks do not exist and that the source control remedy is effective. Modeling was also performed to determine potential risks associated with contaminant migration from surface soils, subsurface soils, and groundwater to exposure points in Gambo Creek. It was determined that 1,1,1-TCA and 1,1-DCA in subsurface soils and groundwater pose a potential risk to ecological receptors in sediment (Tables 2-3, 2-4). Table 2-2 indicates that surface soils do not pose a risk to surface water and sediment at Site 12.

2.6 DESCRIPTION OF ALTERNATIVES

Based on an evaluation of site conditions, potential risks, and legal requirements for Site 12, three remediation goals were identified to protect the public from potential future health risks, as well as to protect the environment:

- o Compliance at Site 12 with contaminant-specific, location-specific, and action-specific Federal and Commonwealth of Virginia ARAR, and to be considered (TBC).
- o Remove 1,1,1-TCA until concentrations are no more than 39.5 mg/kg in subsurface soils in the source area, thereby preventing 1,1,1-TCA from migrating to sediments via groundwater and causing adverse effects in ecological receptors.
- o Remove 1,1-DCA and 1,1,1-TCA until concentrations are no more than 9,650 ug/L and 5,320 ug/L, respectively, in groundwater in the former burn pit area, and thereby prevent them from migrating to sediments and causing adverse effects in ecological receptors.

A detailed analysis of the possible remedial alternatives for Site 12 is included in the Site 12 Feasibility Study report. The detailed analysis was conducted in accordance with the EPA document entitled Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA and the National Oil Hazardous Substances Pollution Contingency Plan (NCP).

The following institutional controls are part of every alternative except the No Action alternative, and shall be undertaken within 90 days of completion of remedial construction: a real property description notation, Base Master Plan notations, and limited site access. Signs shall be posted which state that hazardous substances are present. Signs shall be removed at the completion of the remedy. The Base Master Plan shall note the area as one in which residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at EFA Ches for this site indicating the extent of the area and the fact that solid wastes are present. The institutional controls shall also include the following: Within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of groundwater contamination. Monitoring well locations shall be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and shall not disturb the function of the monitoring systems. The owner of the property shall submit the survey plat to the local

recording authority when closure is complete. If and when the property is transferred out of the Federal government the deed (or some other instrument which is normally examined during title search at the local land recording authority) shall contain the survey plat, a notation notifying any potential purchaser of the property that the land has been used to manage solid waste, and an appropriate deed restriction.

A summary of the remedial alternatives which were developed to address contamination associated with Site 12 is presented below.

Alternative 1 - No Action

The No Action alternative is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Under this alternative, no actions would be taken to reduce the toxicity, mobility, or volume of the contaminated soil or groundwater at Site 12. Alternative 1 serves as a baseline against which the effectiveness of other alternatives is measured.

Alternative 2 - Long-Term Monitoring (Groundwater); Long-Term Monitoring or Excavate Source, Offsite Disposal (Subsurface Soils); Institutional Controls (Groundwater and Soils)

Description:

Under this alternative, institutional controls as outlined above, shall be implemented to eliminate or reduce pathways of exposure to 1,1,1-TCA in subsurface soils, and 1,1,1-TCA and 1,1-DCA in groundwater.

Groundwater contaminants (1,1,1-TCA and 1,1-DCA) in the shallow aquifer shall not be treated, but allowed to degrade over time through natural biodegradation and chemical decomposition processes. Due to its brackish quality and productivity constraints, groundwater at Site 12 in the shallow aquifer is not a current source of drinking water and shall not be used as one in the future. Institutional controls shall be implemented to prevent the use of groundwater at the site for drinking water purposes.

Groundwater, surface water, and sediment shall be monitored to ensure that dispersion/dilution, abiotic degradation and intrinsic bioremediation of 1,1,1-TCA and 1,1-DCA are occurring. Quarterly sampling for VOCs, SVOCs, biodegradation parameters, and metals shall be performed. A site review including long-term monitoring costs shall be conducted every 5 years for 30 years to evaluate the site status and provide direction for further action, if necessary.

It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOCs were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors from metals and SVOCs in surface water or sediments, monitoring shall be conducted to measure concentrations of these constituents in groundwater, surface water, and sediments. Long-term monitoring or the excavation and offsite disposal of subsurface soils in the source area may be considered. The effectiveness of natural processes shall be evaluated during the 5 year review period provided under CERCLA. Soil removal would eliminate VOCs, and DNAPL that would eventually migrate to groundwater and speed up the natural processes. Subsurface soils in the vicinity of the former burn pit shall be excavated if PRGs (Tables 2-2, 2-3, and 2-4) are not achieved within a reasonable time, not to exceed 30 years, and shall be transported to an appropriate facility for disposal. Under this alternative, it is assumed that soils will be characterized as nonhazardous waste. However, if land disposal restrictions (LDRs) are exceeded, the soils would be considered a characteristic hazardous waste under the Resource Conservation and Recovery Act (RCRA). The additional costs that would be incurred to

incinerate the soils at an approved offsite facility are described in Alternative 3B. The area of the source is estimated to be 2,500 square feet, extending to a depth of approximately 8 feet. The total volume to be removed is estimated to be 740 cubic yards, and the area shall be backfilled with clean soil.

During excavation, the potential for erosion shall be minimized by following erosion and sediment control best management practices. Habitat alteration shall be minimal.

The costs for this alternative are:

Estimated Capital Cost:	\$0 for long-term monitoring; \$520,000 for offsite nonhazardous waste landfilling
Estimated Annual O&M Cost:	\$43,500
Estimated 30-year Present Worth:	\$1,178,000 for long-term monitoring; \$1,698,000 for offsite nonhazardous waste landfilling
Time to Implement	Less than one year

Alternative 3A - Pump, Treat, Discharge to Gambo Creek (Groundwater); Long-Term Monitoring (Subsurface Soils); Institutional Controls (Groundwater and Soils)

Description:

This alternative consists of three major components: (1) groundwater extraction, (2) onsite groundwater treatment/discharge to Gambo Creek, and (3) institutional controls.

A groundwater extraction and treatment system would be installed to capture VOC contaminants by restricting migration of the groundwater in the shallow aquifer. Contaminated groundwater migrating within the shallow aquifer and from Site 12 would be captured prior to its discharge into Gambo, Creek. Due to its brackish quality and productivity constraints, groundwater in the shallow aquifer is not a current source of drinking water and will not be used as one in the future.

For costing purposes, the groundwater extraction system would consist of six wells, pumping at an aggregate rate of 40 gallons per minute (gpm), located at the source and within the downgradient boundaries of the plume. Extracted groundwater would be pumped to a newly constructed, centrally located treatment system. For costing purposes, the treatment system would consist of the following processes: equalization, iron oxidation and pH adjustment, clarification, sand filtration, air stripping and sludge handling. Treated groundwater would then be discharged to Gambo Creek from the treatment plant

While there would be no air emissions controls on the air stripper and initially up to 25 pounds per day of VOCs removed from the groundwater would be expected to be vented to the atmosphere, emissions at these levels would be expected to be short term during the installation and pilot testing of the system. Long-term operation of the system would be controlled to address the EPA's Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28 limit of 15 pounds per day VOCs for air emissions from Superfund remedial actions. Based on the fact that the closest potential receptors are over 2,000 feet from Site 12, it is not likely that excess human health risks would be experienced. In addition, prior to implementation, a risk assessment would be conducted to demonstrate that no excess human health risks would result from the emissions.

Contaminated subsurface soils would be addressed through natural processes such as leaching to groundwater, volatilization, and degradation.

Institutional controls, as outlined above, shall be implemented to eliminate or reduce pathways of exposure to contaminants at the site.

In addition, groundwater, sediment, and surface water monitoring shall be conducted. It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOCs were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors in surface water or sediments, monitoring shall be implemented to measure concentrations of these constituents.

This remediation alternative would operate for 12 years. Annual O&M Costs include monitoring costs, which would occur every 5 years for 20 years. Monitoring for 20 years is considered a sufficient period of time to monitor site conditions in view of the length of time required to complete the remediation of the site under this alternative.

The costs for this alternative are:

Estimated Capital Cost:	\$2,212,000
Estimated Annual O&M Cost:	\$140,000
Estimated 30-year Present Worth:	\$4,328,000
Time to Implement:	Less than one year

Alternative 3B - Pump, Treat, Discharge to Gambo Creek (Groundwater); Excavate Source, Offsite Disposal or Offsite Incineration and Disposal (Subsurface Soils); Institutional Controls (Groundwater and Soils)

Description:

This alternative has four major components: (1) groundwater extraction, (2) onsite groundwater treatment/discharge to Gambo Creek, (3) excavation of source area with offsite disposal, and (4) institutional controls. The groundwater treatment component would be the same as Alternative 3A.

Contaminated subsurface soil at the source area exceeding remediation goals would be excavated, based on COC levels, and transported offsite for disposal at a suitable facility. The soil might require treatment to achieve LDRs prior to landfilling if determined to be a RCRA characteristic waste. The area of the source is estimated to be 2,500 square feet, extending to a depth of approximately 8 feet. The total volume of soil to be removed is estimated to be 740 cubic yards. The excavated area would be backfilled with clean soils. Because soils to be excavated have not been characterized for disposal purposes, costs that have been developed include disposal as nonhazardous waste and as hazardous waste (incineration).

During excavation, the potential for erosion will be minimized by following erosion and sediment control best management practices. Habitat alteration will be minimal.

The institutional controls, as outlined above, shall be implemented. In addition, groundwater, sediment, and surface water monitoring shall be conducted. It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOCs were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors in surface water or sediments, monitoring shall be implemented to measure concentrations of these constituents.

This remediation alternative would operate for 12 years. Annual O&M costs include monitoring costs, which would occur every 5 years for 20 years. Monitoring for 20 years is considered a sufficient period of time to monitor site conditions in view of the length of time required to complete the remediation of the site under this alternative.

The costs for this alternative are:

Estimated Capital Cost:	\$2,732,000 for offsite nonhazardous waste landfilling; \$3,420,000 for offsite incineration (including groundwater remediation for both options).
Estimated Annual O&M Cost:	\$140,000/yr
Estimated 30-year Present Worth:	\$4,848,000 for offsite nonhazardous waste landfilling; \$5,536,000 for offsite incineration (including groundwater remediation for both options).
Time to Implement:	One to two years

Alternative 3C - Pump, Treat, Discharge to Gambo Creek (Groundwater); Excavate Source, Onsite Thermal Treatment/Backfill (Subsurface Soils); Institutional Controls (Groundwater and Soils)

Description:

This alternative consists of four major components: (1) groundwater extraction, (2) onsite groundwater treatment/discharge to Gambo Creek, (3) excavation of source area soils with onsite thermal treatment and (4) institutional controls. The groundwater treatment component would be the same as in Alternative 3A.

Contaminated subsurface soil in the vicinity of the former burn pit exceeding remediation goals would be excavated, based on COC levels. Following excavation, the soils would be treated onsite. The soils would be screened prior to treatment using size separation and crushing/grinding techniques, then treated using low-temperature thermal desorption. The throughput is expected to be an estimated 18 tons per day. The area of the source is estimated to be 2,500 square feet extending to a depth of approximately 8 feet. The total volume of soil to be removed is estimated to be 740 cubic yards. The treated excavated soils would then be used as backfill.

During excavation, the potential for erosion will be minimized by following erosion and sediment control best management practices. Habitat alteration will be minimal.

The institutional controls, as outlined above, shall be implemented. In addition, groundwater, sediment and surface water monitoring shall be conducted. It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOCs were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors in surface water or sediments, monitoring shall be implemented to measure concentrations of these constituents.

This remediation alternative would operate for 12 years. Annual O&M costs include monitoring costs, which would occur every 5 years for 20 years. Monitoring for 20 years is considered a sufficient period of time to monitor site conditions in view of the length of time required to complete the remediation of the site under this alternative.

The costs for this alternative are:

Estimated Capital Cost:	\$2,212.000
Estimated Annual O&M Cost:	\$140,000/yr
Estimated 30-year Present Worth:	\$4,328,000
Time to Implement:	One to two years

Alternative 4 - Air Sparging/Soil Vapor Extraction (Groundwater and Soils); Institutional Controls (Groundwater and Soils)

Description:

This alternative involves air sparging/soil vapor extraction (AS/SVE) and institutional controls.

An AS/SVE system shall be installed in the source area (see Figure 2-4 and Figure 2-5) to address the potential presence of DNAPL and to volatilize VOCs in the subsurface soils and groundwater in the shallow aquifer. Due to its brackish quality and productivity constraints, groundwater in the shallow aquifer is not a current source of drinking water and will not be used as one in the future.

The air sparging system shall consist of at least two air injection wells in the source area.

The vapor extraction system shall consist of at least two vapor extraction wells located in the source area (see Figure 2-4 and Figure 2-5) and along the downgradient boundaries of the plume, as defined by the groundwater monitoring well network. The air sparging wells shall be placed approximately 30 feet apart, and the extraction wells shall be placed midway between the air sparging wells. The system shall be designed to accommodate up to six additional AS wells and seven additional SVE wells to address the potential need for future expansion of the system. Extracted vapors shall be monitored to ensure compliance with EPA and Virginia ARARs and TBCs and discharged to the atmosphere. While there will be no air emission controls on the AS/SVE system, and initially up to 25 pounds per day of VOCs removed from the groundwater is expected to be vented to the atmosphere, emissions at these levels are expected to be short-term during the installation and pilot-testing of the system.

Long-term operation of the system shall, if needed, be controlled to meet the OSWER Directive 9355.0-28 limit of 15 pounds per day VOCs for air emissions from Superfund remedial actions. Controls may include reducing air flow into the aquifer, the use of carbon adsorption, or other means acceptable to EPA and VDEQ. Based on the fact that the closest potential receptors are over 2,000 feet from Site 12, it is not likely that excess human health risks will be experienced. In addition, prior to implementation, a risk assessment shall be conducted to demonstrate that no excess human health risks would result from the emissions.

The institutional controls, as outlined above, shall be implemented. In addition, groundwater, sediment, and surface water monitoring shall be conducted. It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOCs were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors in surface water or sediments, monitoring shall be implemented to measure concentrations of these constituents.

This remediation alternative shall operate for 12 years. Annual O&M costs include monitoring costs, which shall occur every 5 years for 20 years.

The costs for this alternative are:

Estimated Capital Cost:	\$293,000
Estimated Annual O&M Cost:	\$73,000/yr
Estimated 30-year Present Worth:	\$1,393,000
Time to Implement:	One to two years

2.7 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives described in Section 2.6 were evaluated in the Feasibility Study against nine criteria identified in the NCP, as presented below.

2.7.1 Threshold Criteria

Overall Protection of Human Health and the Environment

To be protective of ecological receptors in the environment the following Remedial Action Objectives (RAOs) have been developed for Site 12 soil and groundwater to address the primary exposure pathways:

- ø Remove 1,1,1-TCA until concentrations are no more than 39.5 mg/kg in subsurface soils in the source area, thereby preventing 1,1,1-TCA from migrating to sediments via groundwater and causing adverse effects in ecological receptors.
- ø Remove 1,1-DCA and 1,1,1-TCA until concentrations are no more than 9,650 Ig/L and 5,320 Ig/L, respectively, in groundwater in the former burn pit area, and thereby prevent them from migrating to sediments and causing adverse effects in ecological receptors.

Alternative 4 provides the highest level of overall protection of human health and the environment because remediation goals would be achieved quicker and more efficiently than the other alternatives. Alternatives 3A, 3B, and 3C would be protective of the environment, however the time frame for remediation is less certain than Alternative 4.

Institutional controls will limit the use of groundwater and any future residential use of the site. Long-term monitoring of groundwater, surface water, and sediments will also ensure overall protection of human health and the environment. Alternative 2 would be protective of human health and the environment but the remediation time would require an extended monitoring period. Alternative 1 would not be protective of the environment because no measures are taken to achieve RAOs for the site.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternative 4 would comply with all ARARs and To Be Considered (TBC) and in addition shall limit the types and amounts of wastes generated and treated materials to be handled, thereby limiting potential exposures and reducing additional ARARs. Alternatives, 3A, 3B, and 3C would comply with TBCs and ARARs, however achieving the ARARs is less certain and shall require more time. Alternative 3A would not require compliance with any soil-disposal ARARs. The offsite disposal options under Alternative 2 and 3B would require compliance with RCRA land disposal requirements. Alternative 2 would comply with remediation goals for protection of ecological receptors, however long-term monitoring will be required. Alternative 1 will not achieve remediation goals for protection of ecological receptors, nor meet all the ARARs and TBC.

2.7.2 Primary Balancing Criteria

Reduction of Toxicity, Mobility, and Volume

Alternatives 3A, 3B, 3C, and 4 would not achieve a significant reduction of toxicity, mobility, or volume of contaminants through treatment because VOC's would be discharged to the atmosphere. Alternative 4 does not increase the volume of wastes, while Alternatives 3A, 3B, and 3C would increase the volume of wastes by an estimated 500 pounds per week (wet weight) of dewatered sludge from groundwater treatment would be generated and need disposal offsite. The offbase landfilling option under Alternatives 2 and 3B would relocate the waste, the offsite RCRA incineration option under Alternative 3C would treat the soils by desorbing VOCs for eventual recycling or destruction offsite. Alternatives 1 and 2 would not achieve reduction in toxicity, mobility, or volume through active treatment of VOCs.

Long-term Effectiveness

Alternative 4 would remove VOCs from both soils and groundwater to achieve RAOs faster and more efficiently than the other alternatives, and therefore would be the best alternative for long-term effectiveness. In Alternative 4, the use of air sparging has the potential to be more effective in removing VOC's and treating DNAPLs than simple pump and treat alternatives. Alternatives 3A, 3B, and 3C would be effective in the long term because remediation goals for the environment could be achieved, after some time. It should be noted that Alternatives 3A and offbase landfilling options under 2 and 3B would be less effective than Alternative 4 because the source area would be either left in place in Alternative 3A or merely relocated to an offsite location. However, under the RCRA incineration option under Alternatives 2 and 3B, and for Alternative 3C, the source soils would be treated for removal of COCs. Alternative 3B would be more effective than 3A because the removal of contaminated soils in 3B would reduce the magnitude of residual risks to a greater degree than in 3A. Alternative 2 depends on natural processes and monitoring to be effective in preventing the migration of COCS into the environment. Attainment of remediation goals would be prolonged if DNAPL is present, and the data indicate that DNAPL is, most likely, under the Chemical Burn Pit. Alternative 2 would depend on the implementation of remedial actions (i.e., soil excavation and removal) as appropriate if natural processes failed to meet remediation goals. Also, Alternative 2 would depend on long-term implementation of institutional controls for its effectiveness. Alternative 1 would not be effective in the long term because RAOs would not be achieved and there would not be a mechanism in place to ensure protection of the environment.

Short-term Effectiveness

Alternative 4 would have the best potential for short-term effectiveness, because the AS/SVE system takes less time to reach remediation goals and is more efficient than the other alternatives. Alternative 4, the contaminated soils would be remediated in-situ, while Alternatives 3A, 3B, and 3C would require excavation to treat the soils, therefore Alternative 4 would have relatively fewer concerns for exposure to contaminants. Remediation under Alternatives 3A, 3B, and 3C would require longer periods of operation in order to achieve RAOs, and would have additional concerns with respect to producing treatment residuals for disposal, and the need to discharge large quantities of treated water. Alternative 3C would have concerns associated with worker protection during treatment of soils onsite, although appropriate personal protective equipment and site monitoring will reduce the risk. Alternatives 3B and 2 would have additional concerns as associated with potential exposure during the excavation and offsite transport of source soils. Transport vehicles would be covered to reduce spillage and control dust. Although the source would be left in place in Alternative 3A, the duration for attainment of remediation goals would be comparable to Alternatives 3B and 3C, in which the contaminated soils would be removed and/or treated.

Alternative 2 would not be effective in the short-term because natural processes require a long period of time. However, monitoring would provide a mechanism to take further action to mitigate adverse impacts to sediments. The excavation and disposal option under Alternative 2 would provide a measure of short-term effectiveness. Alternative 1 would not be effective in the short term because RAOs would not be achieved and the potential for sediments to be adversely impacted would remain.

Implementability

Alternative 3A, 3B, 3C, and 4 would have similar implementability concerns. Alternative 4 would not have the delays associated with administrative negotiations with the Commonwealth of Virginia for discharges of treated groundwater to Gambo Creek, however, a pilot-scale treatability study will delay full implementation. All equipment and services would be available for AS/SVE implementation. Alternatives 3A, 3B, and 3C would all have common implementability issues with the groundwater remediation system, such as the need to conduct bench-scale treatability studies and, in addition, the need to negotiate with the Commonwealth of Virginia for discharge standards to Gambo Creek. All equipment, services, and disposal facilities would be available for groundwater remediation. Alternative 3A would have no implementability concerns for soil remediation. Alternative 2 and 3B would involve excavation and offsite transport of contaminated soils. For these alternatives, the soil might require treatment to achieve LDRs prior to landfilling if determined to be a RCRA characteristic waste. Alternative 3C would have the greatest implementability concerns with regard to the excavation of source soils and onsite treatment. These concerns would include the need for trained personnel onsite, access to utilities, and bench-scale treatability studies. Alternative 2 would have implementability concerns, such as excavation, transportation, and disposal issues, associated with source removal. Alternative 1 requires no implementation.

Cost

Alternative 4 would be the most cost effective remedy for active remediation. The time to completion for Alternative 4 would be much shorter than the other alternatives, thereby reducing O&M costs. Alternative 4 would have relatively low capital costs, as compared to the pump and treatment alternatives. Capital costs would be relatively high for Alternatives 3A, 3B, and 3C. O&M costs would all be similar for Alternatives 3A, 3B, and 3C. Alternative 2 would have low capital costs associated with the source removal option. Alternative 2 would have relatively low O&M costs compared to the other alternatives. There would be no capital costs and no O&M costs associated with Alternative 1.

The least to most expensive alternatives, based on estimated net present worth, are \$0 (Alternative 1), \$1,178,000 or \$1,698,000 (Alternative 2), \$1,393,000 (Alternative 4), \$4,328,000 (Alternative 3A), \$4,328,000 (Alternative 3C), and \$4,848,000 or \$5,536,000, depending on the disposal alternative chosen (Alternative 3B).

2.7.3 Modifying Criteria

State Acceptance

The Virginia Department of Environmental Quality, on behalf of the Commonwealth of Virginia, has reviewed the information available for this site and has concurred with this ROD and the selected remedy identified below.

Community Acceptance

Community Acceptance summarizes the public's general response to the alternatives described

in the Proposed Plan and the Feasibility Study. No written comments were received during the thirty-day comment period which began on July 16, and ended on August 15, 1997. There were no comments or questions received at the Proposed Plan Public Meeting held on August 6, 1997. The background on Community involvement is included in the Responsiveness Summary, Section 3.0 of the ROD.

2.8 THE SELECTED REMEDY

The selected remedy for Site 12 is Alternative 4 which involves the installation of an AS/SVE system to address the potential presence of DNAPL and to volatilize VOCs in the subsurface soils and groundwater in the shallow aquifer and implementation of institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Surface water and groundwater shall continue to be monitored.

The major components of the selected remedy are:

The Navy shall install an AS/SVE system which consists of at least two air injection wells in the source area as defined in Figure 2-4. The vapor extraction system shall consist of at least two vapor extraction wells located in the source area and along the downgradient plume, as defined by the groundwater monitoring network. The optimum number of AS/SVE wells shall be determined by the pilot-scale study.

The Navy shall monitor the extracted vapors to ensure compliance with EPA and Virginia ARARs and TBCs as they are discharged to the atmosphere.

There will be no air emission controls on the AS/SVE system, and initially up to 25 pounds per day of VOCs removed from groundwater is expected to be vented to the atmosphere. Emissions at these levels are expected to be short-term during the installation and pilot-testing of the system. Long-term operation of the system shall, if needed, be controlled to meet the OSWER Directive 9355.0-28 limit of 15 pounds per day VOCs for air emissions from Superfund remedial actions. Controls may include reducing air flow into the aquifer, use of carbon adsorption, or other means acceptable to EPA and VDEQ.

The Navy shall institute the following institutional controls within 90 days of completion of the installation of the AS/SVE system: a real property description notation, Base Master Plan notations, and limited site access. Signs shall be posted which state that hazardous substances are present. The signs shall be removed at the completion of the remedy. The Base Master Plan shall note the area as one in which residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at Engineering Field Activity, Chesapeake (EFA Ches) (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present. The institutional controls shall also include the following: Within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of groundwater contamination. Monitoring well locations should be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owners future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and shall not disturb the function of the monitoring systems. The owner of the property shall submit the survey plat to the local recording authority when closure is complete. If and when the property is transferred out of the federal government, the deed (or some other instrument which is normally examined during title search at the local land recording authority) shall include the survey plat a notation notifying any potential purchaser of the property that the

land has been used to manage solid waste, and an appropriate deed restriction.

The Navy shall institute groundwater monitoring at the perimeter of the groundwater plume. It is noted that concentrations of metals in groundwater (chromium, copper, iron, and lead) are significantly elevated above background levels. SVOC's were also detected above background levels in some instances. Despite the fact that modeling has not indicated a potential threat to ecological receptors in surface water or sediments, monitoring shall be implemented to measure concentrations of these constituents. The frequency of analysis, types of analyses, and the length of time for monitoring shall be developed in the Operation and Management Plan.

The Navy shall monitor the surface waters and sediments in the Gambo, Creek adjacent to Site 12. The frequency of analysis, types of analyses, and the length of time for monitoring shall be developed in the Operation and Management Plan.

Based on available information and the current understanding of site conditions, Alternative 4 appears to provide the best balance with respect to the nine NCP evaluation criteria. In addition, the selected alternative is anticipated to meet the following statutory requirements:

- ø Protection of human health and the environment.
- ø Compliance with ARARs.
- ø Cost-effectiveness.

The institutional controls will further protect human health and the environment by limiting future land use and by providing continuous monitoring. As discussed previously in this ROD, a separate study will be prepared which addresses possible surface water and sediment contamination in Gambo Creek.

2.8.1 Performance Standards

Air Sparging/Soil Vapor Extraction System

The selected remedy shall consist of a minimum of two air sparging and two soil vapor extraction wells placed in the source area (see Figure 2-4 and 2-5) and along the downgradient plume, as defined by the groundwater monitoring network. (The optimum number of AS/SVE wells shall be determined by the pilot-scale study). The remedy shall achieve the remediation goals provided in Table 2-5 within the area of Site 12.

The Navy shall conduct risk assessment, prior to implementation of the selected remedy, to demonstrate that no excess human health risks result from the planned emissions.

RCRA Groundwater Monitoring Wells

A groundwater monitoring network will be installed around the perimeter of the unit to evaluate the progress of the AS/SVE system and any future contaminant transport. The location and number of monitoring wells, the frequency of analyses, the types of analyses, and the length of monitoring shall be determined in the site design and operation and management documents. These documents must be approved by the EPA and the Commonwealth of Virginia. The wells will be installed according to RCRA and Commonwealth of Virginia construction requirements.

TABLE 2-5

SUMMARY OF REMEDIATION GOALS
NSWCDL DAHLGREN, VIRGINIA

Chemical of Concern	Media	
	Maximum Groundwater Concentration (Ig/l)	Maximum Subsurface Soils Concentration (mg/kg)
1,1,1-Trichloroethane	5,320	39.5
1,1-Dichloroethane	9,650	N/A

Surface Water and Sediment Monitoring

A surface water and sediment sampling and monitoring plan shall be developed as part of the Operation and Management (O & M) Plan. The location and number of sampling locations, the frequency of analyses, the types of analyses, and the duration of monitoring shall be determined in the O & M Plan. This plan must be approved by the EPA and the Commonwealth of Virginia.

Institutional Controls

The Navy shall institute the following institutional controls within 90 days of completion of the installation of the AS/SVE system: a real property description notation, Base Master Plan notations, and limited site access. Signs shall be posted indicating hazardous substances are present. The signs shall be removed at the completion of the remedy. The Base Master Plan shall note the area as one in residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained by Engineering Field Activity, Chesapeake (EFA Ches) (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present. The institutional controls shall also include the following: within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of the groundwater contamination plume. Monitoring well locations shall be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and shall not disturb the function of the monitoring systems. The owner of the property shall submit the survey plat to the local recording authority when closure is complete. If and when the property is transferred out of the federal government, the deed (or some other instrument which is normally examined during title search at the local land recording authority) shall include the survey plat and shall contain a notation notifying any potential purchaser of the property that the land has been used to manage solid waste, and an appropriate deed restriction.

In the yearly O & M Report, the Navy shall certify that the institutional controls as outlined above are still in-place and effective. The Navy shall notify USEPA and VDEQ 60 days before changing any of the use restrictions in the Base Master Plan related to Site 12.

2.9 STATUTORY DETERMINATIONS

Remedial actions must meet the statutory requirements of Section 121 of CERCLA as discussed below.

Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment, comply with applicable or relevant and appropriate requirements of both Federal and state laws and regulations, be cost-effective, and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. Also, remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous waste as the principal element are preferred.

The following discussion summarizes the statutory requirements that are met by the selected remedy.

2.9.1 Protection of Human Health and the Environment

The selected remedy will be protective of human health and the environment because the primary COCs present in the groundwater (1,1,1-TCA and 1,1-DCA) will be removed until risk-based remedial action objectives are achieved. These RAOs were developed during the ecological risk assessment and are based on modeling. The removal of VOCs in the subsurface soils will eliminate potential ecological risks associated with potential VOC migration to groundwater and sediments.

2.9.2 Compliance with ARARs

The selected remedy will achieve all ARARs. ARARs that have been identified for Site 12 are presented in Appendix C.

Discharges of off-gases during the long-term operation of the AS/SVE system shall be monitored and the system operated to maintain compliance with Commonwealth of Virginia regulation 9 VAC 5-50 as well as the EPA OSWER Directive (9355.0-28) limit of 15 pounds per day VOCs for air emissions from Superfund remedial actions, and the Clean Air Act requirements. In addition prior to implementation, a risk assessment shall be conducted to demonstrate that no excess human health risks will result from the emissions. The AS/SVE treatment facility shall be constructed outside the 100-year floodplain, fulfilling the Clean Water Act requirements.

New monitoring wells shall be installed in accordance with Commonwealth of Virginia requirements. The specific analytical methods, procedures and sampling frequency will be specified in the O&M plan. Substantive permit and licensing requirements shall be followed. Land-use and access restrictions, described in Section 2.8, shall limit the use and development of the property.

2.9.3 Cost-Effectiveness

The selected remedy is cost-effective because it will provide overall effectiveness proportional to the cost. Although more costly than long-term monitoring, the selected remedy will achieve remediation goals more quickly and efficiently than other alternatives, provide greater long-term protection of human health and/or the environment, and meet all identified ARARs.

2.9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy uses an alternative treatment technology, AS/SVE. AS/SVE is a permanent solution and is an appropriate remedy for soils and groundwater contaminated with VOCs.

2.9.5 Preference for Treatment as a Principal Element

The selected remedy does not satisfy the statutory preference for treatment as a principal element. Because low levels of VOCs (less than 15 pounds per day) are planned to be generated, no treatment of emissions is planned. If additional volumes of VOCs are generated, the option exists to treat the off gasses. Therefore, this action may satisfy this preference.

3.0 RESPONSIVENESS SUMMARY

The selected remedy for Site 12 is an air sparging/soil vapor extraction system. No written comments, concerns, or questions were received by the Navy, EPA, or the Commonwealth of Virginia during the public comment period from July 16, 1997 to August 15, 1997. A public meeting was held on August 6, 1997 to present the Proposed Plan for Site 12 and to answer any questions on the Proposed Plan and on the documents in the information repositories. No formal questions were asked during the meeting. Based on the limited comments, the Public appears to support the selected remedy.

A copy of the certified transcript of the Public Meeting is attached as Appendix B.

The Virginia Department of Environmental Quality, representing the Commonwealth of Virginia, concurs with the selected remedy.

3.1 Background on Community Involvement

The Navy and NSWCDC have had a comprehensive public involvement program for several years. Starting in 1993, a Technical Review Committee (TRC) would meet on average twice a year to discuss issues related to investigative activities at NSWCDC. The TRC was comprised of mostly governmental personnel, however a few private citizens attended the meetings.

In early 1996, the Navy converted the TRC into a Restoration Advisory Board (RAS) and 8 - 10 community representatives joined. The RAB is co-chaired by a community member and has held meetings approximately every four to six months since. The Feasibility Study for Site 12 and the Proposed Plan were both discussed at the RAB meetings and a Site 12 tour was undertaken during a special RAB meeting.

Community relations activities for the final selected remedy include:

The documents concerning the investigation and analysis at Site 12, as well as a copy of the Proposed Plan was placed in the information repository at the NSWCDC library and the King George Public Library.

Copies of the documents, including the Proposed Plan were sent to members of the RAB.

Newspaper announcements on the availability of the documents and the public comment period/meeting date was placed in the Freelance Star Newspaper on July 15, 1997.

The Navy established a 30-day public comment period starting July 18, 1997 and ending August 15, 1997 to present the Proposed Plan. No written comments were received during the 30-day public comment period..

A Public Meeting was held August 6, 1997 to answer any questions concerning the Site 12 Proposed Plan. Approximately 20 people, including Federal, State and local government representatives attended the meeting.

APPENDIX A

VIRGINIA CONCURRENCE LETTER

APPENDIX B

RESPONSIVENESS SUMMARY

NAVAL SEA SYSTEMS COMMAND

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION

PUBLIC MEETING

WEDNESDAY, AUGUST 6, 1997, 7:00 P.M.

KING GEORGE COUNTY ADMINISTRATION BUILDING
KING GEORGE, VIRGINIA

PROPOSED REMEDIAL ACTION PLAN
Site 12, Chemical Burn Area

USEPA Region III
Hazardous Waste Management Division
Federal Facilities Section
Mr. Bruce Beach
841 Chestnut Building, Philadelphia, Pennsylvania, 19107

Virginia Department of Environmental Quality
Mr. David Gillispie
629 East Main Street, Richmond, Virginia 23225

Public Affairs Office
Commander, Naval Surface Warfare Center
Ms. Jennifer Wilkins
17320 Dahlgren Road, Dahlgren, Virginia 22448

Reported by: Paula J. Evans

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

August 6, 1997:

There were no formal questions on the floor at this Meeting.

FRANCES K. HALEY ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suits 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

CERTIFICATE OF COURT REPORTER

I, Paula J. Evans, hereby certify that I was the

Court Reporter at the Public Meeting held at King George

county Administration Building, King George, Virginia, on

August 6, 1997, at the time of the meeting herein.

I further certify that the foregoing transcript is a

true and accurate record of the proceeding herein.

Given under my hand this 19th day of August, 1997.

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWCDL, Dahlgren, Virginia

ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
I. LOCATION SPECIFIC				
Endangered Species Act of 1978	16 USC 1531-1544 C.F.R. Part 402	Applicable	Act requires federal agencies to ensure that any action authorized by an agency is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat. Similar Virginia requirements for submittal and review of environmental assessments.	Potentially affected endangered species have not been identified. The remedial action will be implemented so resources are not adversely affected should any be identified in the future.
Virginia Endangered Species Regulations	VR 325-01-1 4 VAC 15-20-130			
Virginia Board of Game and Inland Fisheries: Virginia Endangered Plant and Insect Species Regulations	Code of Virginia Sections 29.1-100 and 29.1-563 VR 115-04-01 2VAC 5-320-10	Applicable	The Department of Game and Inland Fisheries (DGIF) determines if rare, threatened or endangered animal species or their habitats are threatened by remediation of the site. Certain species of fish and wildlife are afforded special preservation and protection measures. The Department of Conservation and Recreation (DCR) determines if any ecologically significant areas are threatened by the remediation of the site.	Potentially affected endangered species have been identified. The remedial action will be implemented so resources are not adversely affected should any be identified in the future.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
The Archaeological and Historical Preservation Act of 1974	16 U.S.C º 469	Applicable	Requires actions to avoid potential loss or destruction of significant scientific, historical, or archaeological data.	Site is not known to be within a historically significant area. If future resources are identified actions will be taken to ensure compliance.
Virginia Historic Resources Law	VR 10.1-2200-2214			
Migratory Bird Treaty Act	16 USC Section 703	Applicable	Protects almost all species of native birds in the U.S. from unregulated "take" which can include poisoning at hazardous waste sites.	Remedy will be implemented to ensure that hazardous wastes have no impacts to native birds.
Chesapeake Bay Preservation Act	VR 173-02-01 9 VAC 10-20-10	Applicable	Requires certain locally designated tidal and non-tidal wetlands and other sensitive areas be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, and stormwater management.	Remedy implementation will require construction activities. Actions will address the regulatory requirements.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWCDL, Dahlgren, Virginia

ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Resource Conservation and Recovery Act	40 C.F.R. 264.18 (b)	Applicable	Applies to generation, treatment, storage, or disposal of solid and hazardous waste.	Remedy implementation may produce incidental hazardous wastes which will be managed consistent with federal and Virginia requirements.
	40 C.F.R. 262.10 (a)			
	40 C.F.R. 262.11			
Virginia Solid and Hazardous Waste Management Regulations	9VAC 20-80-10 9VAC 20-60-10			
Virginia Water Control Board Regulations	VR 680-21-04 9 VAC 25-260-10	Relevant and Appropriate	Facility or activity design must adequately address the issues arising from locating in wetlands, delineated (wellhead protection areas determined vulnerable).	Remedy implementation is not expected to involve wetland or wellhead protection areas. If identified, actions will address the regulation.
Executive Order 11990, Protection of Wetlands	40 C.F.R. 6, Appendix A	Applicable	Action to minimize the destruction, loss, or degradation of wetlands.	Portions of the site adjacent to Gambo Creek are characterized as wetlands. Remedy implementation will be completed to avoid wetland impacts.
	Clean Water Act of 1972 (CWA)			
	Section 404		Any Activity to take place in, or impact on, a tidal wetland must meet the provisions of Virginia Wetlands Act and regulations as applicable.	
Virginia Wetlands Regulations	VR 450-01-0051 4 VAC 20-390-10			

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWCDL, Dahlgren, Virginia

ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
II. ACTION SPECIFIC				
Solid Waste Management Act	VR 625-02-00 9 VAC 20-80-10	Relevant and Appropriate	Permanent Closure Criteria governing: Access Restriction, site monitoring, and compliance with other permanent closure requirements.	Installation of the remedy will require on-going institutional controls which will be addressed by the regulations.
Virginia Regulations Governing Transportation of Hazardous Materials (VRGTHM)	VR 670-30-01 9 VAC 20-110-10	Applicable	The VRGTHM designates the manner and method by which hazardous materials are loaded, packed, identified, marked, placarded, stored and transported.	Transportation of Hazardous waste must be conducted in compliance with VRGTHM will be addressed by the regulations.
Erosion and Sediment Control	VR 625-02-00 4 VAC 50-30-10	Applicable	Erosion and sediment control plans are to be submitted for land-disturbing activities, and be in compliance with of the locality and/or local soil and water conservation district.	Construction activities will disturb the land in the vicinity of the site. Activities will address Virginia erosion and sediment control requirements.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWCDL, Dahlgren, Virginia

AIR

Clean Air Act	Clean Air Act 40 C.F.R. 61 Subpart C	Applicable	Stipulate requirements for compliance with emissions of toxic pollutants in attainment and non-attainment areas; permitting procedures and monitoring requirements for processes emitting pollutants.	Remedy implementation will involve discharges of VOCs to the atmosphere. Emissions will be consistent will federal and state regulations.
Virginia Regulations for the Control and Abatement of Air Pollution	Virginia VRCAAP VR 120-01-01 through 120-08-0605 9 VAC 5-10-10 through 5-80-350			
Air Emissions	OSWER Directive 9355.0-28	To Be Considered	For air stripping operations that have no mechanism to capture or treat emissions, emissions are limited to a maximum of 3 pounds per hour or 15 pounds per day of VOCS in ozone non-attainment areas.	Emissions of VOCs from the AS/SVE system will consider limitations on quantity of VOCs discharged.
Virginia Ambient Air Quality Standards	VR120-03-01 9 VAC 5-30-01	Applicable	Stipulates requirements for compliance with emissions of toxic pollutants in attainment and non-attainment areas; permitting procedures and monitoring requirements for processes emitting pollutants; any emission from the disturbance of soil must meet Virginia air emission standards for toxic pollutants particualtes and VOC's.	Remedy implementation will involve discharges of VOC's to the atmosphere. Emissions will be consistent with federal and state regulations.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWCDL, Dahlgren, Virginia

WATER

Water Quality Standards	VR 680-15-02 9 VAC 25-210-10	Relevant and Appropriate	Criteria and standards for groundwater quality. Virginia regulation provides basis for risk-based remediation and discharge limitations.	Provides basis for risk-based decision making, establishes standards for groundwater quality. Ongoing monitoring at Site 12 will address the requirement.
Water Quality Standards	VR 680-15-02 9 VAC 25-210-10	Relevant and Appropriate	Subsurface borings of all types shall be constructed, operated and closed in a manner which Protects groundwater.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.
Water Quality Standards	VR 680-21 -00 9 VAC 25-260-10	Applicable	Groundwater monitoring stations shall be located and constructed in a manner that allows accurate determination of groundwater quality and levels, and prevents contamination of groundwater through the finished well hole or casing. All groundwater monitoring stations shall be accurately located utilizing latitude and longitude by surveying, or other acceptable means, and coordinates shall be included with all data collected.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 12 Chemical Burn Area
NSWC DL, Dahlgren, Virginia

Pollution Discharge Elimination System (VPDES); Virginia Pollution Abatement (VPA) Permit Program	VR 680-14-01 9 VAC 25-30-10	Applicable	Procedures and requirements for discharging pollutants into surface waters, or any activity which impacts physical, chemical or biological properties of surface waters.	Air sparging of groundwater at Site 12 is not expected to produce waste liquids that would be discharged to surface waters. Any future activities or groundwater monitoring (e.g. generation of purge water) will address regulatory requirements.
Water Quality Standards	VR 672-10-01	Relevant and Appropriate	Monitoring well design Standards.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.
Water Quality Standards	VR 672-10-01	Relevant and Appropriate	Monitoring well Drillers certification.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.
Virginia Stormwater Management Regulation	VR 215-02-00 4 VAC 3-20-10	Applicable	All land disturbing activities must be in compliance with local stormwater management programs, where they exist.	Remediation activities must meet requirements.